A1 traversed through the metal plates. The pin stirs the plastic metal surrounding it and therefore joins the two plates together. The process then continues with the pin and the shoulder heating the metal so that it is plasticised and the pin stirring the metal plates together.

REMARKS

In response to the Office Action mailed May 17, 2002, Applicant respectfully requests reconsideration in light of the foregoing amendment to the specification, the following remarks and the attached two-month request for extension of time to respond.

Claims 1, 2 and 7 stand rejected under 35 USC § 102(e) as being anticipated by Waldron et al. (US Patent No. 6,168,067). The Examiner submits that Waldron et al. teaches high strength friction stir welding. The structural members are joined to one another by friction stir welding along the interface of the members which defines a welding path between the members. Frictional heat generated by a rotating probe creates a plasticised region or weld zone between the structural members. The rotating probe is moved along the path defined by the interface between the structural members to thereby form a continuous friction stir weld joint along the length of the members, thus forming a unitary-structural assembly. The size of the heat-affected region may be reduced by applying a continuous stream of cooling through one or more coolant jets. Preferably, the cooling fluid is applied to the weld zone immediately behind the friction stir welding probe or the stream of cooling fluid may be applied in multiple locations to the area of the structural members. The cooling fluid may include any non-reactive liquid coolant or chilled gas. Preferably the cooling fluid includes chilled nitrogen gas. The workpiece may be an aluminum alloy.

Applicant contends that the invention as defined by the specification and claimed in claims 1, 2 and 7 is not anticipated by Waldron et al. A cryogen has a temperature substantially below zero. The description, chilled nitrogen, does not connote a cryogenic temperature. As such, each and every element of Applicant's claims 1, 2 and 7 is not present in the teaching of Waldron et al. As such, Waldron et al. does not anticipate the presently claimed invention. Reconsideration and reversal of this rejection are respectfully requested.

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Claims 3 and 4 stand rejected under 35 USC § 103(a) as being unpatentable over Waldron et al. in view of Soviet Union Patent (SU-414066). The Examiner asserts that the Soviet Union Patent teaches argon arc welding. Resistance of argon arc welds against thermal crack formation is insured by using liquid argon or nitrogen for forced cooling of the weld with cooling streams directed against the movement of the welding head. As such, it would have been obvious to one having ordinary skill in the art to modify the teachings of Waldron et al. with the teachings of the Soviet Union Patent in order to protect the friction stir welding against thermal crack formation. Argon arc welding and friction stir welding are types of thermal welding.

Applicant contends that the invention as claimed is not obvious over the combination of Waldron et al. in view of the Soviet Union Patent. Applicant claims a method of friction stir welding together at least two metallic workpieces including the step of applying at or adjacent a heated welding zone, a cryogen in the form of at least one jet.

In claims 3 and 4, Applicant claims that the liquid cryogen can be nitrogen or heavy argon.

Waldron et al. teaches friction stir welding process. The Soviet Union Patent teaches arc welding. Friction stir welding is a very different process from electric arc welding employing different physical phenomena. In electric arc welding, the weld metal is transferred in molten typically droplet form from a welding wire or electrode to the site of the weld. The molten metal fuses at the site of the weld to join one workpiece to another. In friction stir welding, a tool is employed to plasticise the regions of the two workpieces in the vicinity of the welds such that they join together. There is no melting of metal and, unlike an electric arc welding process, heat is generated internally in the workpieces and is dissipated outwardly. One having ordinary skill in the art would not have viewed cooling practices as inherently being transferable from electric arc welding to friction stir welding and would not have expected the thermal stress pattern in friction stir welding to have the same pattern as in electric arc welding, and would not have looked to the Soviet Union Patent from the teachings of Waldron et al. to protect against thermal crack formation.

As noted in Applicant's specification, page 4, the following effects were observed when using a cryogen to cool metallic components being welded. There was a reduction in control of the level of distortion. There was a reduction of tensile stress. There was protection of heat sensitive components near the welding zone and a reduction of the effects of chemical degradation as a result of heat. Metallurgical properties were also controlled such as the control of grain growth. Rapid cooling was observed thereby permitting handling of the workpieces sooner after welding and there was no problem in the coolant interfering in the welding processes unlike in arc welding processes. As such, based on these observations and the distinctions between the combination of Waldron et al. and the Soviet Union Patent, Applicant submits that this teaching does not obviate the invention of claims 3 and 4. Reconsideration and reversal of this rejection are respectfully requested.

Claims 3 and 5 stand rejected under 35 USC § 103(a) as being unpatentable over Waldron et al. in view of United Kingdom Patent (1 552 660). The Examiner asserts the United Kingdom Patent teaches a method of arc welding and that the toughness of both the weld metal in the heat affected zone will become more pronounced by using higher cooling rates for the forced cooling through the ranges from the maximum temperature to 800° and from 800° to 500°. Specific cooling rates are used to obtain high toughness for the welding metal and the heat affected zone. As cooling agent, water, liquid nitrogen or dry ice may be employed within the scope of the present invention. As such, it would have been obvious to one having ordinary skill in the art to modify the teachings of Waldron et al. with the teachings of the United Kingdom Patent to obtain a high toughness for the welding metal and the heat affected zone.

Applicant contends that this combination does not obviate the invention of claims 3 and 5. Waldron et al. wants to cool so as to reduce the size the heat affected zone, notably in column 2, lines 25-28. The United Kingdom Patent addresses the problem of toughening the weld metal. Notably on page 2, lines 15-18, that the toughness of both the weld metal and the heat affected zone become more pronounced by using higher cooling rates for the forced cooling to the ranges from the maximum of 800° and from 800° to 500°C. Applicant submits that the Waldron et al. solution of using coolant to reduce the size of the heat affected zone is the distinct

problem from a cooling process to toughen the weld metal and as such Applicant would not be motivated from the teaching of Waldron et al. to look to a process for toughening of weld metal to achieve the advantages listed above as these are two distinct and different problems. Indeed, United Kingdom Patent prefers water to cryogenic coolants as noted on lines 26-28 of page 2 where it is observed that the cooling rate in the range of 800° to 500°C with a cryogenic coolant is less than that achieved with water. As such, this combination of Waldron et al. in view of the United Kingdom Patent does not teach nor does it suggest the invention of claims 3 and 5. Reconsideration and reversal of this rejection are respectfully requested.

Claims 3, 5 and 6 stand rejected under 35 USC § 103(a) as being unpatentable over Waldron et al. in view of Terai et al. (US Patent No. 3,836,748). Terai et al. teaches a process of welding a high tension steel by metal arc inert gas welding. The subzero treatment is conducted by contacting the weld metal with any suitable coolant. The particular coolant used is not critical and examples are dry ice, mixtures of dry ice with metal or ethyl alcohol and liquid nitrogen. As such, the Examiner contends that it would have been obvious to one having ordinary skill in the art to modify the teachings of Waldron et al. with the teachings of Terai et al. in order to provide a process of welding without softening or crack formation at the heat affected portion of the welded metal. Metal arc inert gas welding and friction stir welding are types of thermal welding.

Applicant contends that there is no teaching or suggestion to combine Terai et al. with that of Waldron et al. Terai et al. teaches toughening the weld metal like the United Kingdom Patent. However, unlike the United Kingdom Patent, the toughening of the weld metal is performed after welding or after the weld step has been made. As such, this does not constitute part of the welding process. Indeed, it is noted that a desirable result in Terai et al. is achieved if one waits 20 to 320 minutes after welding to begin the subzero treatment noted on column 3, lines 1-4. As such, Applicant contends that the combination of Waldron et al. and Terai et al. does not teach or suggest the invention of claims 3, 5 and 6 because the process of subzero treatment in Terai et al. does not form part of the actual welding process. As such, this combination cannot be used to obviate the invention as claimed. Reconsideration and reversal of this rejection are respectfully requested.

The prior art made of record and not cited has not been discussed as it is considered less relevant than that art relied upon.

For these reasons, Applicant submits that the invention as claimed defines patentable subject matter and is in condition for allowance. Prompt favorable action to that end is respectfully requested.

The Examiner is invited to call the undersigned should any issue arise during reconsideration of the present application.

Respectfully submitted,

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Enclosure
Petition for Two-Month Extension of Time

PVN:bjl